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AGRICULTURAL EXPERIMENT STATION

OF THE

COLLEGE OF AGRICULTURE AND

MECHANIC ARTS

WEST RALEIGH

FEEDING EXPERIMENTS WITH COWS AND CALVES

I. COMPARISON OF COTTON-SEED HULLS AND SHREDDED CORN STOVER FOR MILK PRODUCTION

II. CORN MEAL VERSUS A MIXTURE OF CORN MEAL AND DRIED BREWERS' GRAINS AS A SUPPLEMENT TO COTTON-SEED MEAL FOR MILK PRODUCTION

III. ROLLED OATS AS A PARTIAL SUBSTITUTE FOR MILK IN CALF FEEDING

N. C. COLLEGE OF AGRICULTURE AND MECHANIC ARTS

THE NORTH CAROLINA

AGRICULTURAL EXPERIMENT STATION

UNDER THE CONTROL OF THE

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CONCLUSIONS.

The cottonseed hulls and shredded corn stover fed in this experiment were of equal value as milk and butterfat producers. It should be stated, however, that the hulls were of good average quality, while the stover was below average, especially in palatability.

It is a wasteful practice for farmers to purchase cottonseed hulls at $8.00 per ton when shredded corn stover of inferior quality can be fed with equally satisfactory results.

Rolled oats constitute an excellent substitute for milk in calf feeding. They are highly relished by young calves and materially reduce the cost of feeding where no skimmed milk, or an insufficient amount, is available for the purpose.

The results indicate that 4.4 cents worth of rolled oats (the cost of one pound) when fed in moderate quantity, is nearly equal to one gallon of whole milk.

With corn stover as the exclusive roughage, corn meal and dried brewers' grains have practically equal feeding value when supplemented by a grain ration consisting of one-half cottonseed meal and one-quarter corn meal.

With most cows, the continuous feeding of corn stover as the exclusive roughage results in too rapid shrinkage in milk flow for best returns.

The results of these experiments incline us to recommend to dairymen who are feeding much corn stover, a grain ration consisting approximately of one-half cottonseed meal, one-quarter corn meal, and one-quarter dried brewers' grains, or wheat bran or some other similar light, fluffy, concentrate, depending upon the relative market price of these feeds.

COMPARISON OF COTTONSEED HULLS AND SHREDDED CORN STOVER FOR MILK PRODUCTION.

By JOHN MICHELS, Dairy Husbandman.

Statistics recently gathered by the writer show that a large number of dairymen in North Carolina feed cotton-seed hulls, either alone or in combination with other coarse feeds, as roughage for dairy cows. Indeed it was found that hulls were fed more largely than any other kind of roughage. More than one and one-half times as much hulls as corn stover are being fed.

Why farmers will continue to pay high prices for hulls rather than feed stover can be explained only on the supposition that they do not fully realize the feeding value of stover. This belief is strengthened by the fact that many of them do not even attempt to harvest corn stalks, but allow them to go to waste in their fields.

OBJECT AND PLAN OF EXPERIMENT.

In view of the facts presented above, it was thought desirable to demonstrate the feeding value of corn stover by feeding it in comparison with cotton-seed hulls, one of the most commonly fed roughages.

For this experiment seven grade cows, from two to three months in lactation, were fed during three periods. The roughage consisted of shredded corn stover in the first and third periods, and of cotton-seed hulls in the second period. Closing the test with the same roughage used at the beginning tends to balance up any changes in milk and butter-fat yield due to advanced stage of lactation and the unfavorable effects of continued feeding on dry roughage. The grain ration was the same throughout the test. It consisted of a mixture of 4 pounds of cotton-seed meal, 2 pounds of dried brewers' grains, and 1 pound of linseed meal. All cows received 8 pounds of the grain mixture per day except Nos. 6 and 7, which received 10 pounds. The amount of roughage which the cows received was the same throughout the test, being 14 pounds per individual, with the exception of cows Nos. 1 and 4, each of which received 16 pounds per day.

Each period lasted twenty-two days exclusive of thirteen days preliminary feeding for Periods II and III and twenty days preliminary feeding for Period I. The longer preliminary feeding for Period I was thought desirable because the cows did not take very kindly to an all-dry feed after having been on a ration of equal

parts of stover and silage for more than two months prior to the experiment.

The milk from each cow was weighed daily, and weekly determinations were made on composite samples of the milk by the Babcock test. All cows were weighed once a week.

The hulls were mixed with the concentrates before feeding. The stover, on the other hand, was always fed after the concentrates.

The corn from which the stover was made was thoroughly matured before cutting and allowed to stand in small shocks in the field from six to eight weeks, during which time it had received several drenching rains. There was practically no green color left in the stover at the time of shredding; neither were there any corn grains or nubbins found in it. On the whole, the stover was of a rather inferior quality. The following analyses, supplied by the Chemical Division, gives an idea of the grade of the different feeds used in this and the following experiments:

TABLE I.—Percentage Composition of Feeds.

Feed.	Moisture.	Protein.	Fat.	Nitrogen—Free Extract.	Crude Fiber.	Ash.
Cottonseed Hulls	10.76	5.72	1.04	29.07	51.17	2.24
Cottonseed Meal	6.87	38.93	10.53	28.08	8.79	6.80
Linseed Meal	8.03	34.87	8.81	34.18	8.83	5.28
Dried Brewers Grain	7.92	22.56	5.76	42.14	18.33	3.29
Corn Stover	7.83	4 04	1.31	47.29	35.18	4.35

MILK AND BUTTERFAT PRODUCTION.

The milk and butterfat yielded by each cow during the test are shown in the following table:

TABLE II.—Showing Milk and Butterfat Yields, and Live Weight.

No. Cow.	Period.	Milk—Pounds.	Fat—Per cent.	Butterfat—Pounds.	Average Weight of Cows—Pounds
1	I. Stover	335.2	5.0	16.76	660
	II. Hulls	332.8	5.4	17.97	656
	III. Stover	316.7	5.4	17.10	639
2	I. Stover	400.2	4.1	16.40	687
	II. Hulls	342.	4.2	14.36	687
	III. Stover	316.6	4.2	13.30	672
3	I. Stover	405.4	4.4	17.83	587
	II. Hulls	353.4	4.9	17.31	571
	III. Stover	340.3	4.8	16.33	569

TABLE II.—Continued.

No. Cows.	Period.	Milk—Pounds.	Fat—Per cent.	Butterfat—Pounds.	Average Weight of Cows—Pounds.
4	I. Stover	434.4	4.5	19.55	824
	II. Hulls	375.	4.7	17.62	794
	III. Stover	331.	4.6	15.23	767
5	I. Stover	468.7	4.5	21.19	805
	II. Hulls	409.8	4.5	18.44	785
	III. Stover	363.4	4.5	15.35	806
6	I. Stover	359.7	4.4	15.82	784
	II. Hulls	278.5	4.8	13.36	769
	III. Stover	262.4	4.7	12.33	778
7	I. Stover	335.6	5.2	17.45	683
	II. Hulls	322.9	5.4	17.43	657
	III. Stover	284.3	5.7	16.77	658

From the results contained in Table II it will be seen that all cows fell off in milk yield during the Hull period and again during the Stover period following, the amount varying with different individuals. It is noteworthy also that in the case of cows Nos. 3, 4 and 6 the percentage of fat present in the milk was a trifle higher in the Hull period than in the Stover period. This may possibly be due to the rather large shrinkage in milk in these instances.

The total yield of milk and butter-fat for each period is shown in the table below:

TABLE III.—Showing Total Yield of Milk and Butterfat and Total Live Weight.

Periods.	Milk—Pounds.	Butterfat—Pounds.	Live Weight—Pounds.
I. Stover	2739.2	125.0	5030
II. Hulls	2414.4	116.5	4919
III. Stover	2224.7	107.4	4889

Averaging the results of the two stover periods in Table III we find that the cows yielded 2482.0 pounds of milk during the Stover period against 2414.4 pounds for the Hull period. Similarly the cows during the Stover period yielded 116.2 pounds of butter-fat as against 116.5 pounds for the average of the Hull periods, showing in this experiment that cotton-seed hulls and corn stover had practically equal value as milk and butter-fat producers.

Table II shows that the average weight of the individual cows was less during the Hull period than during the first Stover period, excepting cow No. 2, whose weight remained the same. Going from the Hull period to the last Stover period we find that four of the cows lost in weight, two gained and one remained practically unchanged.

Taking the weights of the cows collectively, we find that they averaged 111 pounds less in the Hull period than in the first Stover period, and 30 pounds less in the last Stover period than in the Hull period.

On the whole it may be concluded that the cotton-seed hulls and corn stover used in the experiment had about equal value in maintaining the live weight of the cows.

HULLS AND STOVER REFUSED.

The roughage refused at each feed was weighed and recorded separately for each cow. It was found that the amount of stover refused averaged from 3 to 4 pounds per cow, with the exception of cow No. 3 (the lightest in weight), which refused from 4 1-2 to 5 pounds daily.

At the beginning of the Hull period an attempt was made to feed the hulls and concentrates separately. This proved a failure, since most of the cows refused the hulls, and only a few ate as much as one-half the allowance supplied them. After the second day, therefore, the hulls were always mixed with the concentrates before feeding. Even when fed in this manner some of the cows showed a strong dislike for the hulls the first week, after which practically the entire amount supplied was consumed except in the case of cows Nos. 6 and 7, each of which would occasionally refuse from 1 to 3 pounds per day.

CORN STOVER.

For years corn stover has formed an important part of the roughage fed to cattle in the live stock sections of this country. This feed is especially suited for feeding in cotton growing sections where the majority of farmers have insufficient stock to warrant the erection of silos; and even where farmers have silos there will always be more or less stover to feed because of the large amount of corn which is planted solely for the grain it yields, leaving the stover as a by-product. But because it is a by-product it is not necessarily to be inferred that it is worthless; yet so it is undoubtedly considered by many, as evidenced from the thousands of acres of cornstalks which are allowed to go to waste in the fields every fall.

An important consideration in making stover is to have it palatable. The corn should therefore be cut as soon as sufficiently ma-

tured, and be placed in shocks containing from one hundred to two hundred stalks. During fair weather the corn may be husked, as a rule, from two to three weeks after it is cut. When husked by a machine the stover is shredded at the same time, and placed under shelter. When husked by hand the stover should be sheltered with the same care and promptness. Long exposure of the stover in the fields greatly diminishes its nutritive qualities as well as its palatability. The damage to stover is especially great when drenched by heavy rains.

It is usually best to cut the stover in small pieces, say from one to three inches long, before feeding. Less is wasted by cattle in this way than when fed uncut or unshredded. There are thousands of stockmen, however, who are at present feeding uncut stover, and our own experience along this line convinces us that dairymen would save considerable money by feeding even the uncut stover, rather than purchasing cotton-seed hulls.

While much has been said in favor of feeding corn stover, it should be distinctly understood that the greatest feeding value of the corn plant is obtained when placed in the silo.

COTTONSEED HULLS.

Aside from their low nutritive value cotton-seed hulls do not seem very well suited for dairy cows, on account of their low palatability and digestibility. With the cows used in these experiments it was found that a majority refused the hulls when they were offered them unmixed with concentrated feeds. When mixed with the concentrates the cows would eat them, largely because they were obliged to do so in order to get the concentrates. On general principles it can not be considered good feeding to thus force cows to swallow a lot of unpalatable material, especially when such material has such a low digestibility. Digestion experiments show that only 41 per cent of the total dry matter in hulls is digestible as against 60 per cent for corn stover. Our experiments were of too short duration to show any appreciable digestive disturbances from the feeding of such undigestible material as cotton-seed hulls, but it can not be denied that continuous feeding of any undigestible feed must ultimately prove deleterious to the usefulness of a dairy cow.

CORN MEAL VERSUS A MIXTURE OF CORN MEAL AND DRIED BREWERS' GRAINS AS A SUPPLEMENT TO COTTONSEED MEAL FOR MILK PRODUCTION.

OBJECT OF EXPERIMENT.

A problem that confronts many farmers is to find a cheap and satisfactory grain supplement to cotton-seed meal for dairy cows. Owing to its high protein content, cotton-seed meal can not be satisfactorily used as the sole concentrate, except possibly where silage, made from well-eared corn, constitutes the roughage.

Hitherto wheat bran has been commonly fed in connection with cotton-seed meal and when the latter is not too high priced, this combination gives very satisfactory returns. But during the past year the price of wheat bran has been so high as to make its use as a cow feed almost prohibitive.

A careful study of prices of different feeds suggested the use of either corn meal or dried brewers' grains, or both, as a satisfactory supplement to cottonseed meal. Both of these feeds could be bought at a lower price than wheat bran, and both were believed to have a higher feeding value.

The dried brewers' grains are of a light, fluffy nature and are highly relished by cattle; yet, owing to their high protein content, the objection may be raised that they do not form a balanced ration with cottonseed meal.

From the standpoint of balancing the nutrients in a ration where much cottonseed meal is fed there appears to be no feed more ideal than corn meal. But owing to the heavy nature of both the corn and cottonseed meal a combination of the two would ordinarily be considered liable to give rise to digestive disturbances.

The above possible objection to corn meal and dried brewers' grains suggested that a combination of the two would probably give the most satisfactory results when used to supplement cottonseed meal, and that possibly corn meal alone could be advantageously used for this purpose if no digestive troubles should arise on account of the heavy character of this feed. Accordingly it was decided to test these points by feeding a mixture of corn meal, dried brewers' grains and cottonseed meal in comparison with a mixture of corn meal and cottonseed meal.

PLAN OF EXPERIMENT.

Six grade cows, from three to four weeks in lactation, were used for the experiment. The feeding was divided into three periods. During the first period the cows received cottonseed meal and corn meal in equal proportions. In the second period the cows received a mixture of 4 parts cottonseed meal, 2 parts corn meal and 2 parts

dried brewers' grains. The feed in the third period was the same as that of the first. The daily allowance of grain per cow during the entire test amounted to 10 pounds for cows Nos. 4 and 5, and 9 pounds for cows Nos. 2, 3 and 6. The roughage supplied throughout the test consisted of 14 pounds of shredded corn stover per cow daily. The stover was the same as that used in the Stover and Hull Experiment.

Each period lasted twenty-one days, and only Period I was preceded by seven days preliminary feeding. Closing the experiment with the same ration used at the beginning tended to balance up any changes in milk and butter-fat yield which might be attributable to the advancing stage of lactation, to loss of continuous feeding of unpalatable roughage, to change in weather and other environmental factors.

The grain was always fed before the roughage. The milk from each cow was weighed daily, and weekly samples of the milk were tested by the Babcock test. All cows were weighed regularly once a week.

The results obtained with the individual cows during the different periods of the test are presented in the following tables:

TABLE V.—Showing Milk and Butterfat Yields and Live Weight.

No. Cow.	Period.	Milk—Pounds.	Fat—Per cent.	Butterfat—Pounds.	Average Weight Cows—Pounds.
	I	528.1	4.36	23.03	721
1	II	511.6	4.20	21.49	717
	III	493.4	4.10	20.23	719
	I	527.1	4.13	21.77	603
2	II	459.0	4.30	19.74	606
	III	412.0	4.16	17.14	612
	I	455.5	4.36	19.86	787
3	II	410.8	4.43	18.30	767
	III	390.9	4.26	16.65	784
	I	542.7	4.40	23.85	724
4	II	486.4	4.45	21.64	738
	III	461.3	4.30	19.84	740
	I	612.8	4.00	24.51	795
5	II	528.8	3.90	20.62	786
	III	494.0	3.93	19.41	796
	I	520.2	.83	19.92	876
6	II	462.9	3.80	17.59	854
	III	428.2	3.73	15.97	847

Summarizing the results contained in Table V we find the following:

TABLE VI.—Showing Total Yield of Milk and Butterfat and Total Live Weight.

Period.	Ration.	Milk—Pounds.	Butterfat—Pounds.	Live Weight—Pounds.
I	Corn + Cottonseed Meal	3186.4	132.97	4506
II	Corn + Dried Brewers' Grains + Cottonseed Meal	2859.5	119.38	4468
III	Corn + Cottonseed Meal	2679.8	109.24	4498
Average of Periods I and III		2933.1	121.10	4502

An inspection of the results in the two preceding tables shows there was a gradual falling off in the milk and butter-fat yield of the cows, individually as well as collectively, from the beginning to the end of the test. The decrease was so uniform that it could not, therefore, be attributed to a change in the grain ration, but must be laid to the unpalatable roughage fed. Table VI shows that the average milk and butter-fat yield of Periods I and III, in which corn meal and cotton-seed meal were fed, was slightly larger than that of Period II, in which dried brewers' grains replaced pound for pound one-half of the corn meal fed in Periods I and III.

Although no digestive disturbances resulted from the feeding of the combination of corn meal and cottonseed meal, yet the trial was too short to warrant a statement as to what the effects of such a mixure of heavy feeds might be, if fed continuously for a longer time.

Pending further investigation along this line, therefore, we are inclined to recommend to dairymen who are feeding much stover a grain ration consisting approximately of one-half cottonseed meal, one-quarter corn meal and one-quarter dried brewers' grains, or wheat bran, or some similar light, fluffy concentrate, depending upon the market prices of these feeds.

ROLLED OATS AS A SUBSTITUTE FOR MILK IN CALF FEEDING.

One of the essentials in building up a productive dairy herd is to raise the heifer calves from the best milkers. This is also the surest way to keep a herd free from disease. Moreover, where skimmed milk is available for feeding, the practice of raising the best calves is also the cheapest means of increasing and improving the dairy herd.

Hundreds of dairymen, however, who are supplying milk to towns and cities either have no skimmed milk at all or an insufficient quantity for calf rearing. Hence they prefer killing the calves to feeding them high-priced milk. In order to induce this class of dairymen to raise their calves, it became clear to us that some cheap and satisfactory substitute had to be found that would take the place of high-priced milk for feeding.

Grade Calf Reared on Rolled Oats.

In our efforts to find such a substitute, we were guided by the following requirements: that a feed that could take the place of milk for young calves must be very palatable and digestible, rich in muscle and bone-forming materials, and practically free from crude fibre. Cooked rolled oats suggested themselves as meeting all these requirements with the exception, perhaps, that there might be a possible deficiency in ash or bone-forming material. This feed was therefore given a careful test.

It was estimated in the beginning, from the composition of the feeds, that one pound of rolled oats was approximately equal in feeding value to one gallon of whole milk, and our feeding trials were conducted upon this basis. The rolled oats were prepared by adding boiling water to them at the rate of one gallon of water to twelve ounces of rolled oats, and the mixture was then allowed to stand until cool enough to feed.

The feeding of a number of calves was simplified by preparing the rolled oats for all in a can of suitable size, from which the proportionate amount for each calf was measured out with a dipper.

All the calves used in the experiment, with one exception, were grade Jerseys, light to medium in weight. The daily allowance per calf during the thirteen weeks of the experiment was as follows:

First week—10 pounds whole milk.
Second week—8 pounds whole milk, 4 ounces rolled oats.
Third week—6 pounds whole milk, 8 ounces rolled oats.
Fourth week—4 pounds whole milk, 12 ounces rolled oats.
Fifth week—2 pounds whole milk, 12 ounces rolled oats, 0.2 pound grain mixture.
Sixth week—2 pounds whole milk, 12 ounces rolled oats, 0.4 pound grain mixture.
Seventh week—2 pounds whole milk, 12 ounces rolled oats, 0.6 pound grain mixture.
Eighth week—2 pounds whole milk, 12 ounces rolled oats, 0.8 pound grain mixture.
Ninth week—2 pounds whole milk, 12 ounces rolled oats, 1.0 pound grain mixture.
Tenth week—12 ounces rolled oats, 1.0 pound grain mixture.
Eleventh week—12 ounces rolled oats, 1.0 pound grain mixture.
Twelfth week—12 ounces rolled oats, 1.2 pounds grain mixture.
Thirteenth week—12 ounces rolled oats, 1.2 pounds grain mixture.

The grain mixture consisted of one part each of corn meal, linseed meal and wheat bran.

The milk was always added to the oat preparation just previous to feeding.

In addition to the above feeds, the calves received all the hay they would eat during the winter, while in spring they received one feed of hay with pasturage additional.

On the basis that one pound of rolled oats is equal to one gallon of whole milk, and that whole milk is worth 8 cents per quart to milkmen, the cost of the milk for a thirteen-weeks-old calf receiving no rolled oats is $26.96. When rolled oats (which cost 4.4 cents per pound delivered in barrel lots) are substituted for milk as shown above, the cost of the calf feed for the same period is only $12.46, a saving of $14.50 in favor of the rolled oats.

The weekly weights of the calves fed rolled oats and those of two calves fed skimmed milk as a check on the work are presented in the following table:

TABLE VII.—Showing Weekly Gains of Calves Fed Rolled Oats and Skimmed Milk.

Age of Calf.	Weekly Weight of Calves—Pounds.										
	Rolled Oats.									Skimmed Milk.	
	Calf No. 1.	Calf No. 2.	Calf No. 3	Calf No. 4.	Calf No. 5.	Calf No. 6.	Calf No. 7	Calf No. 8.	Calf No. 9.	Calf No. 10	Calf No. 11
At birth	63	83	62	60	62	60	66	50	49	60	46
One week	69	94	70	65	70	.....	.....	.....	.....	63	52
Two weeks	78	101	77	70	73	.....	.....	.....	.....	74	62
Three weeks	84	106	85	74	74	.....	.....	.....	67	82	67
Four weeks	88	115	88	81	81	.....	.....	.....	.....	87	74
Five weeks	94	128	93	86	86	100	.....	76	.....	97	82
Six weeks	99	131	102	88	90	104	.....	.....	.....	106	90
Seven weeks	108	140	111	91	98	108	.....	.....	.....	115	96
Eight weeks	118	147	120	101	107	114	.....	.....	.....	122	100
Nine weeks	125	159	129	112	115	123	.....	.....	.....	135	113
Ten weeks	139	167	140	122	124	129	.....	.....	.....	146	125
Eleven weeks	151	171	151	134	137	139	144	.....	.....	159	130
Twelve weeks	170	178	159	141	145	153	154	.....	.....	170	137
Thirteen weeks	180	188	169	155	155	166	163	168	159	180	146
Average daily gain	1.28	1.16	1.18	1.00	1.00	1.16	1.09	1.30	1.12	1.32	1.10

Skimmed-milk calf No. 10 received the following daily ration:
First week—10 pounds whole milk.
Second week 7 pounds whole milk and 4 pounds skimmed milk.
Third week—4 pounds whole milk and 8 pounds skimmed milk.
Fourth week—2 pounds whole milk, 10 pounds skimmed milk.
Fifth to fourteenth week—14 pounds skimmed milk.

Calf No. 11 received only 8 pounds of whole milk the first week, and subsequently was fed the same allowance of whole milk as calf No. 10, but received 2 pounds less of skimmed milk per day. The grain and roughage for the two skimmed-milk calves were the same as those for calves fed on rolled oats.

Table VII shows that the calves fed on rolled oats made practically the same gains as those fed skimmed milk.

Considering that all calves but No. 2, which was a grade Holstein, were light-weight, common-grade Jersey calves, and that the allowance of whole milk and the rolled oats equivalent were less than is usually fed, the gains here reported are considered as fairly satisfactory. The calves showed good bone and muscle development.

We strongly recommend the feeding of cooked rolled oats to calves for all who either have no skimmed milk or an insufficient

quantity for calf-rearing; and we confidently expect that a trial by such dairymen will result in the rearing of every calf that promises to become a valuable animal in the dairy.

One thing that especially commended itself in the rolled oats feeding was the evident relish with which the calves devoured them. The extra labor entailed in the feeding of the rolled oats was insignificant as compared with the saving effected.

One precaution to observe in feeding rolled oats to calves is not to use it in too large quantities, owing to the laxative character of this feed. Indeed, our experience indicates that it is best not to feed more than 12 ounces daily to each calf. It is important also that the rolled oats and milk be supplied as near the temperature of blood heat as possible.

In these trials the grain was always supplied first and the roughage later, the milk and oats being fed immediately after the grain. The latter was fed from a sterile tin bucket, which was also used for feeding the milk and rolled-oat mixture.

The calves were removed from the cows when twenty-four hours old, and received regularly two feeds daily, except during the first few days, when they were fed three times per day.